Attorney Docket No.: A4182/T34100 AMAT No.: 004182/ETCH/CORE/TECH/PJS

## WHAT IS CLAIMED IS:

1	1 1. A plasma processi	ng apparatus comprising:			
2	2 a single carrier source ada	pted to generate a first RF signal at a carrier			
3	3 frequency;				
4	4 a modulation source adapt	a modulation source adapted to generate a second RF signal at a			
5	5 modulation frequency;	nodulation frequency;			
6	6 a modulator adapted to mo	dulate the first RF signal with the second RF			
7	7 signal to form an amplitude modulated si	al to form an amplitude modulated signal, wherein the amplitude modulated signal			
8	8 contains peaks with amplitudes greater th	contains peaks with amplitudes greater than or less than amplitudes of the peaks of the			
9	9 first RF signal; and	first RF signal; and			
10	0 a plasma processing cham	a plasma processing chamber coupled to the modulator.			
1	1 2. The apparatus of co	aim 1 further comprising:			
2	2 a power amplifier adapted	to amplify the amplitude modulated signal from			
3	the modulator to generate a high power amplitude modulated signal.				
1	1 3. The apparatus of c	aim 1 further comprising:			
2	2 a transmission line for transmission	smitting the amplitude modulated signal; and			
3	a single impedance matchi	ng network, wherein the single matching			
4	4 network is adapted to receive the amplitu	network is adapted to receive the amplitude modulated signal and provides impedance			
5	5 matching from the transmission line to th	matching from the transmission line to the plasma.			
1	1 4. The apparatus of c	aim 1 wherein the modulation source is further			
2	2 adapted to generate a third frequency mod	adapted to generate a third frequency modulating RF signal, and the modulator is further			
3	3 adapted to modulate the first RF signal w	adapted to modulate the first RF signal with the second RF signal and the third RF signal			
4	4 to form an amplitude and frequency mode	to form an amplitude and frequency modulated signal.			
1	1 5. The apparatus of c	aim 1 wherein the second RF signal is in the			
2	2 form of a sine wave.				
1	1 6. The apparatus of c	aim 1 wherein the apparatus is an etching			
2	2 apparatus.				
1	1 7. A plasma processing	ng apparatus comprising:			

2	a carrier source adapted to generate a first RF signal at a carrier frequency;			
3	a modulation source adapted to generate a second RF signal at a			
4	modulation frequency;			
5	a modulator adapted to modulate the first RF signal with the second RF			
6	signal to form a frequency modulated signal; and			
7	a plasma processing chamber coupled to the modulator.			
1	8. The apparatus of claim 7 further comprising:			
2	an amplifier adapted to amplify the frequency modulated signal to generate			
3	a high power frequency modulated signal.			
1	9. The apparatus of claim 7 further comprising:			
2	a transmission line for transmitting the frequency modulated signal; and			
3	a single matching network adapted to receive the frequency modulated			
4	signal to provide impedance matching from the transmission line to a plasma.			
1	10. The apparatus of claim 7 wherein the modulation source is further			
2	adapted to generate a third RF signal at an amplitude modulation frequency, and wherein			
3	the modulator is further adapted to modulate the first RF signal with the second RF signal			
4	and the third RF signal to form an frequency and amplitude modulated signal.			
1	11. The apparatus of claim 7 wherein the second RF signal is in the			
2	form of a sine wave.			
1	12. The apparatus of claim 7 wherein the apparatus is an etching			
2	apparatus.			
1	13. The apparatus of claim 7 wherein the modulation frequency is less			
2	than about 0.1 times the carrier frequency.			
1	14. A method of delivering power to a plasma processing chamber, the			
2	method comprising:			
3	generating a first RF signal at a carrier frequency;			
4	generating a second RF signal at a modulating frequency;			

5	forming an amplitude modulated signal by modulating the first RF signal			
6	with the second RF signal, wherein the amplitude modulated signal contains peaks with			
7	amplitudes greater than or less than amplitudes of peaks of the first RF signal; and			
8	delivering only the amplitude modulated signal to a reactant gas within the			
9	plasma processing chamber to form a plasma.			
1	15. The method of claim 14 further comprising, prior to generating the			
2	plasma:			
3	amplifying the amplitude modulated signal to form a high power			
4	amplitude modulated power signal, and wherein			
5	delivering plasma within the plasma processing chamber using the			
6	amplitude modulated signal comprises using the high power amplitude modulated signal			
7	to generate the plasma.			
1	16. The method of claim 14 wherein the second RF signal has a lower			
2	frequency than the first RF signal.			
1	17. The method of claim 14 wherein forming an amplitude modulated			
2	signal comprises:			
3	forming an amplitude and frequency modulated RF signal with the second			
4	RF signal and a third frequency modulating RF signal.			
1	18. The method of claim 14 further comprising:			
2	modifying the amplitude modulated signal by adjusting a modulation			
3	index.			
1	19. The method of claim 14 wherein the second RF signal comprises a			
2	signal of form $\beta \sin(\omega_m t)$ , wherein $\beta$ is a modulation index and is less than or equal to 1,			
3	$\omega_{\rm m}$ is the modulating frequency, and t is time.			
1	20. The method of claim 14 wherein the amplitude modulated signal is			
2	of the form $E_o[1+\beta\sin(\omega_m t)]\sin(\omega_c t)$ wherein $\beta$ is a modulation index, $\omega_m$ is the			
3	modulating frequency, $\omega_c$ is the modulation, $E_o$ is an initial electric field, and t is time.			
1	21. The method of claim 14 further comprising passing the amplitude			

modulated signal through an impedance matching network.

1		22.	The method of claim 14 wherein second RF signal is in the form of	
2	a sine wave.			
1		23.	A method of delivering radio frequency (RF) power to a plasma,	
2	the method c	omprisi	ng:	
3		generating a first RF signal at a carrier frequency;		
4		generating a second RF signal at a modulation frequency;		
5		formi	ing a frequency modulated signal by modulating the first RF signal	
6	with the seco	rith the second RF signal; and		
7		gener	rating a plasma within the plasma processing chamber using the	
8	frequency modulated signal.			
1		24.	The method of claim 23 further comprising:	
2		ampl	ifying the frequency modulated signal to generate a frequency	
3	modulated po	wer si	gnal, and	
4		wherein generating a plasma comprises using the frequency modulated		
5	power signal	power signal to generate a plasma.		
1		25.	The method of claim 23 wherein forming the frequency modulated	
2	signal compr	ises:		
3		form	ing a frequency and amplitude modulated signal by modulating the	
4	first RF signs	first RF signal with the second RF signal, and a third amplitude modulating signal.		
1		26.	The method of claim 23 wherein the modulation frequency is less	
2	than about 0.	1 times	s the carrier frequency.	
1		27.	The method of claim 23 wherein the frequency modulated power	
2	signal is of the		$E(\omega_{c},t) = E_{o}[\exp(i\omega_{c}t)] \exp[i\beta \sin(\omega_{m}t)].$	
1		28.	The method of claim 23 wherein the carrier frequency is 13.56	
1	MITT	20.	The method of claim 25 wholem the carrier requests is 2000	
2	MHz.			
1		29.	The method of claim 23 further comprising passing the frequency	
2	modulated e	ional th	rough an impedance matching network.	

1		30.	The method of claim 23 wherein the second RF signal is in the	
2	form of a sine	wave.		
1		31.	A power system for a plasma processing apparatus, the power	
2	system compr	ising:		
3		a sing	le carrier source adapted to generate a first RF signal at a carrier	
4	frequency;			
5		a mod	lulation source adapted to generate a second RF signal at a	
6	modulation fr	nodulation frequency; and		
7		a mod	lulator adapted to modulate the first RF signal with the second RF	
8	signal to form	form an amplitude modulated signal, wherein the amplitude modulated signal		
9	contains peak	ins peaks with amplitudes greater than or less than amplitudes of the peaks of the		
10	first RF signa	1.		
1		32.	A power system for a plasma processing apparatus, the power	
2	system compr	rising:		
3		a carrier source adapted to generate a first RF signal at a carrier frequency		
4		a moo	dulation source adapted to generate a second RF signal at a	
5	modulation frequency; and			
6		a moo	dulator adapted to modulate the first RF signal with the second RF	
7	signal to form a frequency modulated signal.			